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Published in:
MUM '19

DOI:
10.1145/3365610.3368425

Published: 01.01.2019

Document Version
Publisher's PDF, also known as Version of record

Citation for pulished version (APA):
Häkkilä, J., Colley, A., Hannula, P., Luiro, E., Launne, E., Mustonen, S., & Westerlund, T. (2019). Visiting a Virtual Graveyard: Designing Virtual Reality Cultural Heritage Experiences. In G. Jacucci , F. Paternò, M. Rohs, & C. Santoro (Eds.), *MUM '19: Proceedings of the 18th International Conference on Mobile and Ubiquitous Multimedia* (pp. 56:1-56:4). ACM . https://doi.org/10.1145/3365610.3368425

Visiting a Virtual Graveyard - Designing Virtual Reality Cultural Heritage Experiences

Jonna Häkkilä,[1], Petri Hannula[2], Elina Luiro[1], Emilia Launne[1], Sanni Mustonen[2], Toni Westerlund[2] and Ashley Colley[1]

[1] University of Lapland, Rovaniemi, Finland. firstname.lastname@ulapland.fi
[2] Lapland University of Applied Sciences, Rovaniemi, Finland. firstname.lastname@lapinamk.fi

Figure 1: Virtual visit to the Salla historical graveyard.

ABSTRACT

Virtual reality offers a potential solution to enable visiting inaccessible cultural heritage sites. We present the design, prototyping and evaluation (n = 6) of a virtual visit to a historic graveyard. The Salla World War II graveyard is located in an inaccessible border zone between Finland and Russia. Our virtual graveyard, accessed through a head mounted display, aimed to create an as accurate as possible simulation of the Salla graveyard, including its atmosphere. Users are enabled to navigate the virtual graveyard and place a candle on a grave. Although the simulation was considered immersive, participants wished for more authenticity and details, e.g. being able to light the virtual candle. The work opens discussion on the need for dignity in the design of virtual experiences for sensitive cultural heritage sites.

CCS CONCEPTS

• **Human-centered computing → Human computer interaction (HCI)**; *User studies*; *Information visualization*; • **Applied computing → Arts and humanities**.

MUM 2019, November 26–29, 2019, Pisa, Italy

ACM ISBN 978-1-4503-7624-2/19/11.
https://doi.org/10.1145/3365610.3368425

KEYWORDS

Cultural heritage, virtual heritage, graveyard, cemetery, deathscapes, virtual reality, experience design, death, WW2, museum.

ACM Reference Format:
Jonna Häkkilä, Petri Hannula, Elina Luiro, Emilia Launne, Sanni Mustonen, Toni Westerlund and Ashley Colley. 2019. Visiting a Virtual Graveyard - Designing Virtual Reality Cultural Heritage Experiences. In *MUM 2019: 18th International Conference on Mobile and Ubiquitous Multimedia (MUM 2019), November 26–29, 2019, Pisa, Italy.* ACM, New York, NY, USA, 4 pages. https://doi.org/10.1145/3365610.3368425

1 INTRODUCTION

The digital age has opened new opportunities for presenting and accessing historical information and cultural heritage. Virtual reality (VR) has been harnessed as a medium for cultural heritage content, providing a new and immersive way to present topics to the audience. One of the general motivations for using VR is to enable visiting inaccessible locations [10], and many historical sites are difficult to access, e.g., due their distant location, vulnerability, or political reasons. Moreover, as Correll has pointed out, there is also an ethics dimension to be considered in the information visualization [6], which is an important part when designing for a context fulfilled with human tragedy, as here, the lives that succumbed to the war.

One example is the graveyard for fallen German soldiers from the Continuation War (part of WW2), which now lies in the border zone between Finland and Russia. Accessing the graveyard is difficult due its location, requiring a border zone permit from the Russian border authorities, the application process for which can

be lengthy. To improve the accessibility of the graveyard, we created a virtual environment that enables the relatives of the buried, history enthusiasts, and students to visit the graveyard virtually. We describe our process to design the virtual visitor experience to the historical graveyard, Figure 1. We present the design process, implementation, and an initial user study evaluating the experience of virtually visiting the graveyard. Additionally we discuss our experiences of working with this sensitive design context.

2 RELATED WORK

Prior work relevant to our topic comes from the areas of virtual reality used in cultural heritage and HCI for deathscapes.

2.1 Virtual Access to Cultural Heritage

A wide variety of solutions have been presented exploring approaches to enable access to, or to digitally enhance experiences in, cultural heritage sites. Bekele et al. [3] present a meta-review of prior works applying Virtual and Augmented reality solutions to cultural heritage applications. A virtual experience of Han Chang'an City is presented by Feng et al. [8], which aims to provide personalised guidance and content to visitors. In an implementation of an outdoor VR environment, with similar environments to our graveyard case, John et al. [13] highlight differences in acceptance based on the user's prior experience level with VR systems. Interactive applications used at the cultural heritage sites itself include e.g. a multimodal mobile UI for guiding people visiting un-supervised archaeological sites by McGookin et al. [14], and audio based UI for experiencing the historical riots in Nottingham, UK [9].

2.2 Designing for Deathscapes

Prior work in the HCI field has addressed digital solutions for graveyards [1, 5, 11, 12]. For example, Ciolfi and Petrelli [5] presented a digital guide book and Augmented Reality (AR) binoculars to provide graveyard visitors with more informed experiences. Similarly, the future cemetery project in Bristol, UK, utilized projection on physical objects within the cemetery to enhance the graveyard experience [1]. A graveyard navigator, enabling the visitor to navigate to specific graves and to highlight links between graves, was demonstrated by Häkkilä et al. [12]. Rather being a mirror world for a physical graveyard, the limited availability of burial sites in some cities has driven the introduction of 'virtual only' burials in virtual cemeteries [2]. Focusing on creating a tangible recreation of an inaccessible grave, Häkkilä et al. [11] presented a dynamic gravestone, with different content triggered by inserting RFID equipped cards.

3 THE SALLA MUSEUM

The Salla museum, located in a small town on Finland's eastern border, specialises on the history of the second world war (WW2) and the reconstruction period following it. Currently, its exhibits are primarily based on information boards and basic AV media techniques (Figure 2). The museum is located nearby a cultural heritage site, a WW2 graveyard, located nearby but on the Russian side of the border. The museum was interested in exploring new ways to exhibit information on historical sites and particularly to support visitors wishing to know more about the historical graveyard.

Figure 2: Examples of existing exhibits at the Salla museum.

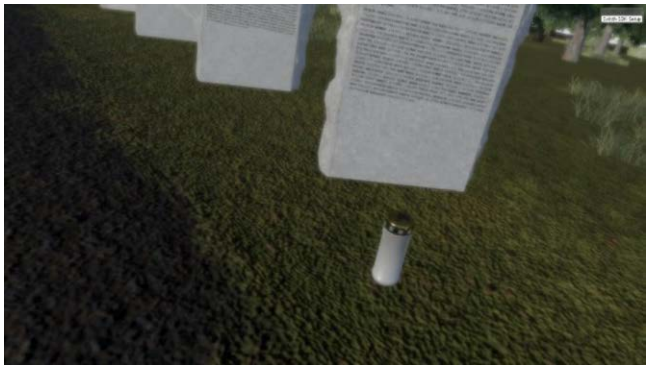

Figure 3: A candle placed in front of a gravestone

The graveyard for fallen German soldiers was founded during the Continuation War (part of WW2), in 1941 in the former village of Salla, nowadays called Old Salla. The graveyard is now located in Russia, within the border zone between Finland and Russia. Approximately 8000 German soldiers who fell in the battles near Kantalahti and Kiestinki are buried in the graveyard. In addition, the remains of soldiers found by search parties in recent years have also been buried there. The graveyard attracts visitors interested in history and family heritage. However, accessing the graveyard is difficult due its location in the border zone, as the access requires a border zone permit from the Russian border authorities, for which the application process can be lengthy.

As background research, the design team visited the Salla museum and discussed with museum personnel to gain their insights for the virtual graveyard concept. Additionally, a local historian with experience of visiting the Old Salla graveyard, and who had photographs of the area, was consulted. Due to the visa requirements, the design team have so far been unable to personally visit the Salla graveyard.

4 VIRTUAL GRAVEYARD PROTOTYPE

The Oculus Rift CV1 was selected as the target head mounted display (HMD) hardware for our prototype. The project was developed using Unity3D, and 3D-models, based on photographs taken by previous visitors, were created in Blender. To optimise the models, a high-lowpoly pipeline approach was used. Textures were generated from a high poly model and then applied to a low poly model.

The target of our implementation was to create an as accurate as possible virtual simulation of the Salla graveyard. We aimed to recreate the mood of the graveyard, including changing daylight and weather conditions. As our designers were unable to visit the area, the implementation was based on photographs taken by previous visitors to the graveyard. Based on discussions with the museum staff, a list of potential features for the virtual graveyard was developed. In the first iteration of the prototype, we selected 3 features to focus on, 1) enabling the user to light and place a candle, 2) volumetric clouds, and, 3) spatial audio. Other suggested features, such as simulating the evolution of the graveyard over the years, e.g. trees growing, were interesting, but beyond the scope of our initial implementation.

The candle-lighting feature enabled the user to pick up a candle, using the handheld VR controllers, light it and leave it at any location in the scene, for example next to a gravestone, Figure 3. Although realistic clouds can be created by other approaches, after a short time users easily notice repeating patterns - hence we selected to implement clouds using volumetic modelling, which also adds to the mood of the scene. The addition of spatial audio increases the level of immersion in the VR world, e.g., in the graveyard location during the summer there are many mosquitoes which the user can hear flying around them. Although the names on the gravestone were placed as close to correctly as possible, from the information available, to ensure readability they had to be rendered in a substitute font, that was close in appearance to the original.

5 USER STUDY EVALUATION

To evaluate our prototype virtual visit to the Salla graveyard, we arranged a user study.

5.1 Study Procedure

The study consisted of two parts. After completing a consent form and background questionnaire, participants were asked to complete a set of tasks in the virtual graveyard, Figure 5, thinking aloud whilst they did so. The tasks the participants were asked to complete were:

(T1) Put on the HMD - look around and listen
(T2) Walking navigation
(T3) Navigation by teleportation [4]
(T4) Walking to and investigating a gravestone
(T5) Walking to and investigating the monument
(T6) Placing a candle
(T7) Visualisation of the number of fallen soldiers, Fig. 4

After completing the tasks, participants completed an end questionnaire which also asked for feedback on 6 additional concept ideas for the virtual graveyard:

(C1) A link from the gravestone to a map showing the location where the body originally lay
(C2) Showing the virtual graveyard at different times of the day or seasons of the year
(C3) Placing a wreath or flowers on a grave
(C4) Planting a small tree in the graveyard and watching it grow remotely from home
(C5) Detailed information on individual soldiers linked to their grave e.g. photos, personal histories etc.
(C6) Taking photos of the virtual visit.

Figure 4: Visualisation of the number of fallen soldiers

Figure 5: The user study setting

The virtual graveyard prototype was evaluated with a user study with six adults (age 21-38, 5 female). Three participants had previously tried a VR headset. Each test session lasted approximately 60 minutes.

5.2 Results

Participants gave generally positive feedback on the immersiveness of the virtual environment (Task T1). However, there were some wishes for improvements in the sharpness and detail of the experience especially when viewing objects close up (T4, T5). Two participants commented on the 'edge of the world' experience [15], e.g., "over there doesn't not show anything, just a grey background". There were mixed feelings about the insect sounds, with some finding it part of the genuine experience, enhancing the immersion level, whilst others found it annoying, e.g. "it is not a calm feeling with those insects". The lack of wind noise was commented by one participant, noting that the trees were swaying without the sound of wind.

Considering the navigation, either walking (T2) or teleportation (T3), the majority of participants preferred teleportation. Walking was perceived as being too slow, although two participants mentioned that this slow walking added to the overall experience. It was commented that simply increasing the walking speed would create a feeling of nausea, due to the 'head-bob' movement included in the

walking cycle. Teleportation was noted as more challenging and difficult to accurately control, e.g. one participant accidentally moved to be on top of the grave monument. The general idea of placing a candle was liked, but the interaction mechanics were problematic. More authenticity in 'picking up' the candle and placing it to the ground was wished. This interaction was commented as not being sufficiently dignified for the graveyard context. Similarly it was stated that the sense of authenticity could be enhanced by enabling the ability to actually light the candle. The visualization of the total amount of fallen soldiers (T7) was considered a good addition to the graveyard environment, however it was commented that more visual detail in the soldiers would make the experience even more touching.

As general feedback, participants commented that the VR hand controllers were too complex, with too many buttons. This created a need the focus on the technology, which took their attention away from emotional aspects. It was commented that elderly people would have some challenges with the visiting the virtual graveyard, and having some kind of assistant would be helpful. When a tourist group would visit the virtual graveyard e.g. in the museum, it was preferred that each would have their own private view of the virtual graveyard, rather than being able to see other concurrent visitors in the virtual environment. The six additional concepts (C1 - C6) presented to the participants raised mixed feeling. On the one hand, the additional features were seen as needed for visitors who had no emotional bond to the graveyard. Whilst the other hand, the graveyard was perceived as a sacred place where nothing extra was wanted.

6 DISCUSSION

Whilst our study participants were all relatively young adults, such virtual reality solutions should be accessible to the broad range of society, including the elderly with little or no training. With this view many of the findings from our study become amplified in importance, e.g. the complexity of the VR systems hand-controllers and the difficulty in controlling teleportation based navigation. Currently VR solutions such as the Oculus Rift used in our evaluation are primarily driven by the gaming industry, the requirements of which may be vastly different from those required for the set of limited interactions in a graveyard environment. Here review of approaches for improving the accessibility of VR, e.g. through the use of custome controllers, may be of benefit [7]. Similarly, the 'head-bob' walking animation we adopted from first person shooter (FPS) games, likely has an overall negative impact on the user experience in our usage context. Graveyards have traditionally been places that are often remote and hidden from the world, now digital tools have opened up new ways to experience them. Yet, graveyards remain a context where the possible introduction of technologies should be done with special care and consideration due the sensitivity of the design context, from the viewpoints of both cultural and individual experiences.

Potential limitations to our findings arise from our small sample size and high likelihood of novelty effects in our participant group of inexperienced head mounted display users. A future work we plan to explore the use of optimised custom controllers for interaction in our virtual graveyard.

7 CONCLUSION

We have presented the design, prototyping and evaluation of a virtual reality application enabling a virtual visit to the Salla World War II graveyard, located in an inaccessible border zone between Finland and Russia. Whilst we aimed to create as realistic as possible virtual environment, study participants still wished for more detail and authenticity. Comparison between hand controller button based walking and teleportation based navigation was inconclusive, with pros and cons being noted for both approaches. The need for dignity in such sensitive cultural heritage environments was highlighted, e.g. a virtual candle should be respectfully placed on a grave, rather than dropped.

ACKNOWLEDGMENTS

This work has received funding from the European Regional Development Fund (ERDF) for the project Lapland Experience Technologies 2025.

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